Review

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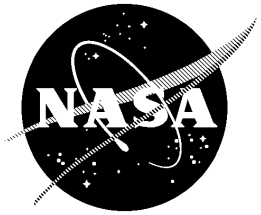
Earth Science Data and Information System (ESDIS) Level 1 Product Generation System (LPGS) Interface Definitions Document (IDD)

May 1997



National Aeronautics and Space Administration

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Review

Earth Science Data and Information System (ESDIS)
Level 1 Product Generation System (LPGS)
Interface Definitions Document (IDD)

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Abstract

This interface definitions document (IDD) presents the functional, performance, operational, and design requirements for the interfaces between the Level 1 Product Generation System (LPGS) subsystems.

This document provides a current understanding of the definition of the interfaces between the LPGS subsystems. It will be baselined by the LPGS during the LPGS detailed design activities.

Keywords: *interface definitions document (IDD), Level 1 Product Generation System (LPGS)*

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Section 1. Introduction

1.1 Purpose

This interface definitions document (IDD) presents the interface requirements between the Level 1 Product Generation System (LPGS) subsystems located at the Earth Resources Observation System (EROS) Data Center (EDC). It is an evolutionary document that will be updated as development progresses toward critical design.

1.2 Scope

This document provides the functional, performance, operational, and design requirements for the LPGS subsystem interfaces. It is intended for all parties requiring such information, including system engineers and system designers responsible for implementing the interfaces and the system maintenance personnel responsible for maintaining the interfaces.

1.3 Organization

This document is organized into three sections. Section 1 provides an introduction. Section 2 includes all Process Control Subsystem (PCS) interfaces. The PCS controls the management of the work order flow executed by the other five subsystems: the Data Management Subsystem (DMS), Radiometric Processing Subsystem (RPS), Geometric Processing Subsystem (GPS), Anomaly Analysis Subsystem (AAS), and Quality Analysis Subsystem (QAS). Section 3 includes the RPS and GPS interfaces.

1.4 Applicable Documents

The following documents contain additional details regarding the LPGS, the Landsat 7 System, and external systems.

1.4.1 Specification Documents

The following documents provide the basis for developing the LPGS subsystem interface definitions presented in this document:

1. Computer Sciences Corporation (CSC), *Level 1 Product Generation System (LPGS) Operations Concept*, February 1997
2. —, *Level 1 Product Generation System (LPGS) System Design Specification*, March 1997
3. —, *Level 1 Product Generation System (LPGS) Functional and Performance Requirements Specifications*, February 1997
4. NASA/GSFC, 430-11-06-007-0, *Landsat 7 0R Distribution Product Data Format Control Book HDF Version* (Review Draft), July 2, 1996
5. —, 430-L-0002-H, *Landsat 7 System Specification*, August 1994

6. Hughes Information Technology Systems, 209-CD-013-003, *Interface Control Document Between EOSDIS Core System (ECS) and the Landsat 7 System*, March 1996

1.4.2 Reference Documents

The following documents contain additional background information related to the Landsat 7 mission and to the Image Assessment System (IAS):

1. NASA/GSFC, *Landsat 7 Level 1 Requirements* (Draft), August 8, 1994
2. AlliedSignal Technical Services Corporation (ATSC), *Landsat 7 Detailed Mission Requirements*, March 1996
3. NASA/GSFC, 430-11-06-003-0, *Landsat 7 System and Operations Concept*, October 1994
4. Martin Marietta Astro Space, CDRL No. A104, *Space Segment Calibration Plan*, August 1994
5. —, 23007702, *Landsat 7 System Data Format Control Book (DFCB) Volume 4 – Wideband Data*, December 2, 1994
6. —, CDRL #A058, 23007610A, *Landsat-7 Program Coordinate System Standard, Revision B*, December 1994
7. United States Geological Survey (USGS)/National Oceanic and Atmospheric Administration (NOAA), *Index to Landsat 7 Worldwide Reference System (WRS)*, 1982

Section 2. PCS and All LPGS Subsystems

The internal communications between the PCS and the other LPGS subsystems is through the LPGS database, as well as through messages that go through sockets, through parameters passed to scripts for execution, and through status codes returned at the end of script execution.

The database maintains the sequence of scripts to be processed for a specified procedure. Locations of flat files, such as image files, calibration files and reports, as well as trending statistics, are stored in the database. The LPGS subsystems use the database to extract the data needed for their processing.

PCS and DMS communicate through the database, through direct messages that use sockets, and through scripts. PCS and AAS communicate through the database only; PCS and QAS communicate through scripts only; PCS and GPS communicate through scripts only; and PCS and RPS communicate through scripts only.

2.1 PCS and DMS

2.1.1 L0R_Stats_Req

2.1.1.1Description

The L0R_Stats_Req interface notifies the DMS that a Level Zero R (L0R) product has been ingested into the LPGS and requires analysis prior to its use in a work order. The image data has to be validated and consensus payload correction data (PCD) and mirror scan correction data (MSCD) files have to be created.

2.1.1.2Format

Table 2–1. Request for L0R Statistics Interface

Parameter	Type	Comment
Filename		

2.1.1.3Data Transfer

Input to DMS from PCS. Sent to DMS from PCS when initiating processing of the appropriate work order script.

2.1.1.4IPC Mechanism

L0R_Stats_Req parameters are passed to DMS from PCS as calling parameters through the script that invokes this process.

2.1.2 L0R_Stats_Status

2.1.2.1Description

The L0R_Stats_Status interface provides processing status to PCS regarding quality control (QC) statistics, image quality, and whether the L0R meets criteria for further processing.

2.1.2.2Format

Table 2–2. L0R Statistics Status Interface

Parameter	Type	Comment
Exit status		Indicates success or failure of the process

2.1.2.3Data Transfer

Input to PCS from DMS. Sent to PCS from DMS on completion of L0R statistics processing.

2.1.2.4IPC Mechanism

The L0R statistics processing performed by DMS is started as a script by PCS. When the DMS child process exits, the process returns an exit status to PCS. The L0R_Stats_Status is captured in the DMS process exit status.

2.1.3 L1_Format_Req

2.1.3.1Description

The L1_Format_Req interface requests that DMS format a Level 1 product prior to its transfer to the Earth Observing System Data and Information System (EOSDIS) Core System (ECS).

2.1.3.2Format

Table 2–3. Request for Level 1 Format Interface

Parameter	Type	Comment
Work order ID		Identifies work order to be used

2.1.3.3Data Transfer

Input to DMS from PCS. Sent to DMS from PCS when formatting a Level 1 product for a work order is necessary.

2.1.3.4IPC Mechanism

The L1R_Format_Req parameters are passed to DMS from PCS as calling parameters through the script that invokes this process.

2.1.4 L1_Format_Status

2.1.4.1Description

The L1_Format_Status interface provides processing status to PCS regarding the formatting of the Level 1 product for transfer to ECS.

2.1.4.2Format

Table 2–4. Level 1 Format Status Interface

Parameter	Type	Comment
Exit status		Indicates success or failure of the process

2.1.4.3Data Transfer

Input to PCS from DMS. Sent to PCS from DMS on completion of Level 1 formatting.

2.1.4.4IPC Mechanism

The Level 1 formatting performed by DMS is started as a script by PCS. When the DMS child process exits, the process returns an exit status to PCS. The L1_Format_Status is captured in the DMS process exit status.

2.1.5 L1_Prod_Xfer_Req

2.1.5.1Description

The L1_Prod_Xfer_Req interface requests DMS to initiate the transfer of a packaged Level 1 product to ECS.

2.1.5.2Format

Table 2–5. Request Transfer of Level 1 Product to ECS Interface

Parameter	Type	Comment
Work order ID		

2.1.5.3Data Transfer

Message sent by PCS to DMS.

2.1.5.4IPC Mechanism

The L1_Prod_Xfer_Req message is sent from PCS to DMS via a socket connection.

2.1.6 L0R_Ingest_Info

2.1.6.1Description

The L0R_Ingest_Info informs DMS that ingestion of level-zero data for a work order is required.

2.1.6.2Format

Table 2–6. Ingest Information Interface

Table	Parameter	Comment
Work orders	Work order ID	
Work orders	Status	Ready for ingest

2.1.6.3Data Transfer

PCS updates the status in the database and DMS reads the status from the database.

2.1.6.4IPC Mechanism

PCS uses database-stored procedures to write L0R_Ingest_Info to the database. DMS uses stored procedures to read it.

2.1.7 L1_Xmit_Info

2.1.7.1Description

The L1_Xmit_Info interface notifies PCS that the delivery of the Level 1 product to ECS has completed successfully.

2.1.7.2Format

Table 2–7. Transfer Information Interface

Table	Parameter	Comment
Work orders	Work order ID	
Work orders	Status	Transfer complete

2.1.7.3Data Transfer

Output from DMS to PCS via database.

2.1.7.4IPC Mechanism

DMS uses a database-stored procedure to write L1_Xmit_Info to the database. PCS uses a database-stored procedure to read it.

2.2 PCS and Operator

2.2.1 Cancellation_Confirm

2.2.1.1Description

Confirmation from the LPGS operator that a product request can or cannot be canceled.

2.2.1.2Format

Table 2–8. Cancellation Confirmation Interface

Parameter	Type	Comment
Work order ID		
Cancellation flag		Cancel or do not cancel

2.2.1.3Data Transfer

Output from the operator to PCS.

2.2.1.4IPC Mechanism

The Cancellation_Confirm is passed from the user interface (UI) to PCS in the form of a message.

2.3 PCS and AAS

2.3.1 Anomaly_Req

2.3.1.1Description

Anomaly_Req is a PCS request that an anomaly be investigated by AAS.

2.3.1.2Format

Table 2–9. Anomaly Request Interface

Table	Parameter	Comment
Anomaly status	Work order ID	
Anomaly status	Anomaly information	

2.3.1.3Data Transfer

Output from PCS to AAS.

2.3.1.4IPC Mechanism

PCS uses a database-stored procedure to write Anomaly_Req to the database. AAS uses a database-stored procedure to read it.

2.3.2 L1_Product_Approval

2.3.2.1Description

Notification that an AAS analyst has approved delivery of the output product for a work order.

2.3.2.2Format

Table 2–10. Level 1 Product Approval Interface

Table	Parameter	Comment
Work orders	Work order ID	
Work orders	Status	Approved

2.3.2.3Data Transfer

Output from AAS to PCS.

2.3.2.4IPC Mechanism

The AAS analyst sends a message via the UI, which calls a database-stored procedure to update the status of a work order. The new status is “approved.” PCS periodically calls a stored procedure to check this status.

2.3.3 AAS_Run_Request

2.3.3.1Description

A request to PCS from the AAS analyst to run a work order anew after the AAS analyst has made some changes in the way the work order is processed, with the expectation that the updated work order will complete successfully.

2.3.3.2Format

Table 2–11. AAS Run Request Interface

Table	Parameter	Comment
Work_Orders	Work order ID	
Work_Orders	Status	

2.3.3.3Data Transfer

Output from AAS to PCS.

2.3.3.4IPC Mechanism

The AAS analyst creates a new work order using the UI and stores it in the database. PCS processes the AAS-created work order just like all other work orders.

2.3.4 Anomaly_Close_Info

2.3.4.1Description

Anomaly_Close_Info is a PCS request that an anomaly be closed out.

2.3.4.2Format

Table 2–12. Anomaly Close Information Interface

Table	Parameter	Comment
Anomaly_Status	Anomaly_ID	
Anomaly_Status	Status	

2.3.4.3Data Transfer

Output from PCS to AAS.

2.3.4.4IPC Mechanism

PCS uses a database-stored procedure to write Anomaly_Close_Info to the database. AAS uses a database-stored procedure to read it.

2.4 QAS and PCS

2.4.1 QAS_Proc_Req

2.4.1.1Description

Request to QAS to perform quality check on the Level 1 image.

2.4.1.2Format

Table 2–13. QAS Processing Request Interface

Parameter	Type
Image type	1R/1G
Thresholds	TBD
Parameters	TBD
Work order ID	

2.4.1.3Data Transfer

Output from PCS to QAS.

2.4.1.4IPC Mechanism

QAS parameters are passed via an operational data logger (ODL) file. PCS builds the ODL file and passes the ODL filename to QAS as a command line argument. QAS reads the ODL file via a global function.

2.4.2 QAS_Proc_Status

2.4.2.1Description

QAS_Proc_Status contains the status of a Level 1 quality check.

2.4.2.2Format

Table 2–14. QAS Processing Status Interface

Parameter	Type	Comment
Exit status		Indicates success, failure, or anomaly

2.4.2.3Data Transfer

Output from QAS to PCS.

2.4.2.4IPC Mechanism

The quality check performed by QAS is started as a script initiated by PCS. When the QAS child process exits, UNIX returns the process exit status to PCS. The QAS_Proc_Status is captured in the process exit status.

2.5 PCS and RPS

The RPS provides radiometric correction of the L0R image. An RPS script starts each RPS program. PCS starts all RPS scripts as part of work order execution. As each RPS script terminates, PCS retrieves the exit status and reports it to the LPGS database.

2.5.1 Proc_Parms

2.5.1.1Description

The Proc_Parms interface contains processing parameters for radiometric characterization and generation of the Level 1R image. PCS retrieves these parameter values from the LPGS database and builds an ODL parameter file. PCS passes the ODL parameter filename to RPS during the fork/exec of the RPS script.

2.5.1.2Format

Table 2–15. Processing Parameters Interface – Radiometric

Parameter	Type	Comment
Scene ID		Specifies 1 to 3 Worldwide Reference System (WRS) row long subinterval
Bands	char 9x2	Bands to be processed (1, 2, 3, 4, 5, 6L, 6H, 7, 8)
Window coordinates		Specifies corner coordinates for processing less that a full scene
Scene type		Used by 1R programs to determine which

		algorithms to invoke (day, night)
Calibration parameter file name	char 256	Default – Calibration parameter file (CPF) bundled with L0R product Option – user-specified custom CPF
Gain_Sources	char 15	Calibration data sources – For gain, sources are IC, prelaunch, postlaunch, current
Bias_Sources	char 15	Calibration data sources – For bias, sources are IC and prelaunch
Apply Relative Gains	char 1	True/false
Fix_Dropped_Lines	char 1	Y/N; substitute, inline, interpolate
Fix_Inoperable_Detectors	char 1	Y/N; substitute, inline, interpolate
Calibration_method	char 1	CPF gains (default) or internal calibrator gains
Map Projection		
SOM		Defined by scene path
UTM_zone	long	Zone number
UTM_base	long	Based on longitude by user must be able to force "1 zone
LCC		
Latitude of First Standard Parallel		
Latitude of Second Standard Parallel		
Longitude of Central Meridian		
Latitude of Projection Origin		
False Easting		
False Northing		
TM		
Scale factor at Central Meridian		
Longitude of Central Meridian		
Latitude of Projection Origin		
OM_projection_type		
Scale Factor at Center of Projection		
Latitude of Projection Origin		
OM_A_1st_long		For OM Type A (two-point description) – Longitude of first point defining central geodetic line of projection
OM_A_1st_lat		For OM Type A – Latitude of first point defining central geodetic line of projection
OM_A_2nd_long		For OM Type A – Longitude of second point defining central geodetic line of projection
OM_A_2nd_lat		For OM Type A – Latitude of second point defining central geodetic line of projection
OM_B_Angle		For OM Type B (azimuthal description) – Angle of azimuth east of north for central line of projection; longitude of point along

		central line of projection at which angle of azimuth is measured
Polyconic		
CM_longitude		Longitude of central meridian
Projection_Latitude		Latitude of projection origin
		Straight line vertical longitude from pole, either standard parallel or scale factor at projection origin
Ellipsoid		Fixed as WGS84
Datum		Fixed as WGS84
reflective_band_pix_size	double	15.000 to 60.000 meters in increments of 0.001 meter (default = 3D 30.000)
Thermal_band_pix_size	double	15.000 to 60.000 meters in increments of 0.001 meter [default = 3D 2 x reflective band pixel size (60.000)]
Pan_band_pix_size	double	15.000 to 60.000 meters in increments of 0.001 meter [default = 3D 0.5 x reflective band pixel size (15.000)]
Resampling_Option		CC, NN, MTFC
Output_Format		HDF, FAST, GeoTIFF

Parameter	Type
Characterize Random Noise	
Number of starting pixel	
Number of swaths to process	
Number of swaths to overlap (all integers)	
Table of ETM+ SNR/NEDL specification	
Histogram Analysis	
Number of scans in window to be used for calculation (default is 374 – one scene)	
Number of scans to overlap between windows (default is 36)	
Number of starting pixel (default is 1)	
Number of pixels for each calculation (default is normal scan length)	
Reference detector (one per band)	
Saturation bin threshold (default is 1000)	
Adjacent bin threshold (default is 10)	
Number of adjacent bin to test (default is 2)	
Process IC Data	
Spectral emissivities of ETM+ structural elements as known measured by SBRS	DN and/or real
Dropped Lines	
Perform_Dropped_Line_Correction:	Logical
Substitute/Interpolate	Character
Dropped_Line_Filled_Values:	Line of different length for different bands (one per each detector of each band); line length may also depend on data (?)
Detector Inoperability	
Perform_Inoperable_Detector_Correction	Logical
Substitute/Interpolate	Character
Inoperable_Detector_Filled_Values	Byte (one per each detector of each band)

Detector Saturation	
Perform_Detector_Saturation_Correction	Logical
Substitute/Interpolate	Character
Detector_Saturation_Filled_Values	Byte (one per each detector of each band)
Characterize Detector Operability	
Upper and lower limits of saturation spectral radiance per band, low-gain and high-gain modes	Float
Characterize and Evaluate Relative and Absolute Radiometry	
Gain source (per detector or per band)	
Ratios	
Output Type (plot, table, both)	
Plot/table time scale (long or short term trends)	
Least squares trend fit	
Detector Gains	
Gain switch (non-default/biases)	
Gain correction	
Prelaunch gains and biases	
Default gain and bias source	
Radiometric correction per band	
DN to radiance conversion factors	
Radiance scale factor exponent	
Detector Temperature	
Reference gains and temperatures	
Temperature sensitivity detector selection	

2.5.1.3Data Transfer

Data from PCS to RPS.

2.5.1.4IPC Mechanism

RPS parameters are passed via an ODL file. PCS builds the ODL file and passes the ODL filename to RPS as a command line argument. RPS reads the ODL file via a global function.

2.5.2 Proc_Status

2.5.2.1Description

PCS is the parent of all RPS scripts. When the RPS script exits, UNIX returns the exit status to PCS.

2.5.2.2Format

Table 2–16. RPS Processing Status Interface

Parameter	Type	Comment
Exit status	Integer	

2.5.2.3Data Transfer

Data from RPS to PCS.

2.5.2.4IPC Mechanism

The radiometric processing performed by RPS is started as a script by PCS. When the RPS child process exits, UNIX returns the process exit status to PCS. The Proc_Status is captured in the process exit status.

2.6 PCS and GPS

2.6.1 Proc_Parms

2.6.1.1Description

The Proc_Parms interface contains processing parameters to perform 1G processing and geometric characterization. PCS retrieves these parameter values from the LPGS database and builds an ODL parameter file. PCS passes the ODL parameter filename to GPS during the fork/exec of the GPS script.

2.6.1.2Format

Table 2–17. GPS Processing Parameters Interface – Geometry

Parameter	Type	Comment
TMINIT		
input_image	char 256	Input image filename to be initialized
meta_opt	char 3	Option to validate the metadata (yes, no)
FDF_name	char 256	Flight Dynamics Facility (FDF) ephemeris filename (option)
TMGRID		
etm+_file_name	char 256	Input 1R or 0R image to generate grid for
tmodel_file_name	char 256	Input Enhanced Thematic Mapper Plus (ETM+) model name
grid_file_name	char 256	Output grid filename
proj_code	long 1	Projection code
proj_zone	long 1	UTM zone code
proj_parms	double 15	Projection definition information
proj_units	char 12	Units the projection distances are in
pixel_size	double 3	Output pixel size – One value for bands 1 to 5 and 7, one value for band 6, and one value for band 8
band_nums	long 9	Band numbers to process
frame_type	long 1	Framing option
frame_coords	double 2x2	Frame coordinates that define the output space (either UL and LR corners, reference point and LR corner, or just UL corner depending on value of frame_type parameter)
coord_unit	char 12	Units of corner_coors (deg, min, sec, dms, pro)
ls_coords	double 2	Line/sample coordinates (used when frame_type = 2)

nlines	long 3	Number of lines in output space (used when frame_type = 3) one value for bands 1 to 5 and 7, one value for band 6, and one value for band 8
nsamps	long 3	Number of samples in output space (used when frame_type = 3) one value for bands 1 through 5 and 7, one value for band 6, and one value for band 8
path	long 1	WRS path number; used for constructing standard path-oriented frame when frame_type = 5
row	double 1	WRS row number (may be fractional); used for constructing standard path-oriented frame when frame_type = 5
TMRESAMPLE		
input_1R_image	char 256	Input 1R or 0R image file name to be resampled
bands	long 9	Which bands to process
output_image	char 256	Output image file name
input_grid	char 256	Input grid file name
terrain_flag	long 1	Flag whether or not to apply terrain correction
in_dem_name	char 256	Input dem image file name (co-registered) (if terrain_flag = True)
terr_tbl_flag	long 1	Flag to read or calculate table of terrain offsets (if terrain_flag = True)
terr_tbl_name	char 256	Name of optional input terrain table (elevation offsets file) (if terrain_flag = True)
delay_flag	long 1	Flag to apply detector delays
odtype	char 4	Output data type (byte, i*2, i*4, r*4,...)
ext_flag	long 1	Flag for saving the extended image
out_ext_name	char 256	Output extended image file name
window_flag	long 1	Window option (in, out)
window	long 4	Window (sl, ss, nl, ns)
resample	char 3	Resampling method (NN, CC, MTF, TABLE)
minmax_output_dn	float 2	Input resample weight table name
pccalpha	float 1	Parametric cubic convolution alpha parameter
backgrnd	float 1	Gray level fill value outside input image
trend_file	char 256	Scan gap statistics file name

2.6.1.3Data Transfer

Data from PCS to GPS.

2.6.1.4IPC Mechanism

GPS parameters are passed via an ODL file. PCS builds the ODL file and passes the ODL filename to GPS as a command line argument. GPS reads the ODL file via a global function.

2.6.2 Proc_Status

2.6.2.1Description

PCS is the parent of all GPS scripts. When the GPS script exits, UNIX returns the exit status to PCS.

2.6.2.2Format

Table 2–18. GPS Processing Status

Parameter	Type	Comment
Exit status	Integer	

2.6.2.3Data Transfer

Data from GPS to PCS.

2.6.2.4IPC Mechanism

The radiometric processing performed by GPS is started as a script by PCS. When the GPS child process exits, UNIX returns the process exit status to PCS. The Proc_Status is captured in the process exit status.

Section 3. RPS AND GPS

3.1 Lev_1R_Image

3.1.1 Description

The Lev_1R_Image contains the location of the Level 1R image generated by RPS calibration and characterization processing. This is passed to GPS for geometric processing. The format will also be passed as documented in a data format control book to be developed. GPS will access the image data through HDF calls.

3.1.2 Format

Table 3–1. L1R Image Interface

Parameter	Type	Comment
Lev_1R_Image		

3.1.3 Data Transfer

Output from RPS to GPS. Sent to GPS at completion of radiometric processing.

3.1.4 IPC Mechanism

The Lev_1R_Image location interface is passed from RPS to GPS via the database. The RPS uses a stored procedure to write the Lev_1R_Image location to the database, and the GPS uses it to retrieve the Lev_1R_Image location from the database.

Acronyms

AAS	Anomaly Analysis Subsystem
CPF	calibration parameter file
DMS	Data Management Subsystem
ECS	EOSDIS Core System
EDC	EROS Data Center
EOSDIS	Earth Observing System Data and Information System
EROS	Earth Resources Observation System
ETM+	Enhanced Thematic Mapper Plus
FDF	Flight Dynamics Facility
GPS	Geometric Processing Subsystem
HDF	
IAS	Image Assessment System
IDD	interface definitions document
IPC	interprocess communication
L0R	Level Zero R
LPGS	Level 1 Product Generation System
MSCD	mirror scan correction data
ODL	operational data logger
PCD	payload correction data
PCS	Process Control Subsystem
QAS	Quality Analysis Subsystem
QC	quality control
RPS	Radiometric Processing Subsystem
UI	user interface
WRS	Worldwide Reference System